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ACCIDENT EXPERIENCE AND COST IN TENNESSEE COAL MINES[1]

By F. E. Cash[2]

PURPOSE OF THIS REPORT

Much has been written concerning accidents in coal mines; the fact that accidents cost the employer and employee money is generally well known, but how much accidents actually cost is vague, even in the minds of many operators. Unquestionably there are hazards in coal mining, but many of them can be eliminated; and from the prevention of accidents there can be realized a material saving in dollars and cents as well as in human suffering.

In presenting the frequency, severity, and cost of accidents in some Tennessee coal mines, it is hoped that other mines in Tennessee, as well as mines in other States, will by a comparison of the data with their own experience be enabled eventually to reduce the number of their accidents.

TENNESSEE WORKMEN'S COMPENSATION LAW

The Tennessee Workmen's Compensation Law was approved on April 15, 1919, and amended on March 31, 1923, and April 14, 1927; it is entitled "An Act to Provide an Elective System of Workmen's Compensation for Industrial Accidents." This act covers coal mines employing five or more men.

A case of temporary disability compensation begins on the eighth day, and if it is of such nature that it extends over a period of 6 weeks or more, the first 7 days are compensable. The act further provides for payment of one-half the average weekly wage, stipulating a minimum of $5 and a maximum of $16 per week.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6664."

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Schedule of Compensation

The specified compensable periods are not given in full in the schedule of compensation, but they cover the accidents which are discussed in this report. In Table 1 the lost days allowed by the Tennessee compensation act appear in column 2; that the severity of accidents may be compared with experience in other mines and in other States, column 3 contains the lost days specified for permanent injuries used by the United States Bureau of Mines, the National Safety Council, and others in determining and comparing accident severity.

Table 1.- Scale of time losses for weighing deaths and permanent injuries in Tennessee

1	2	3
Disability	Days lost	
	Tennessee compensation law	National safety competition
Death	2,800	6,000
Permanent total disability	3,850	6,000
Loss of thumb	420	600
Loss of index finger	245	300
Loss of second finger	210	300
Loss of third finger	140	300
Loss of fourth finger	105	300
Loss of big toe	210	300
Loss of hand	1,050	3,000
Loss of arm	1,400	3,600
Loss of foot	875	2,400
Loss of leg	1,225	3,000
Loss of eye	700	1,800

TENNESSEE ACCIDENT EXPERIENCE

During the period 1926 to 1931, inclusive, the State of Tennessee produced 33,245,840 tons of coal with 142 fatal accidents in and around the mines The fatality rate per million tons mined was below or better than the average for the United States for each year except 1926, when the State had its only major disaster, resulting in the death of 31 men, during the 6-year period.

That the accident experience may be comparable with coal mines of the State of Tennessee as a whole, it is deemed expedient to present in tabular form the relation of fatal accidents to operation of coal mines for the period 1926 to 1931, inclusive. Table 2 was compiled from publications and data furnished by the Tennessee Department of Mines.

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Table 2.- Relation of fatalities to operation in all Tennessee coal mines, 1926-1931, inclusive, according to the State Department of Mines

Year	Mines operating	Coal produced, tons	Average days active	Total employed	Man-days worked	Fatal accidents	Tons per fatality	Man-days per fatality	Fatalities per million tons mined
1926	133	6,089,162	234	8,374	1,959,516	49	124,065	39,990	8.04
1927	111	5,935,150	221	7,574	1,673,854	17	349,126	92,579	2.86
1928	116	5,545,672	218	7,449	1,523,902	19	291,877	80,205	3.39
1929	81	5,663,155	241	7,720	1,860,520	21	269,676	88,596	3.68
1930	74	5,382,607	196	7,730	1,514,080	20	269,130	75,704	3.70
1931	71	4,630,094	185	6,794	1,256,890	16	289,381	78,556	3.48
Totals or averages	-	33,245,840	216	-	9,788,762	142	234,126	68,935	4.27

ACCIDENTS IN THIRTEEN REPRESENTATIVE MINES

The following data were furnished by representatives of 13 operating companies who requested that their names be withheld:

It has been possible to obtain the direct cost of accidents from 13 mines. By direct cost is meant money spent by the operating companies for medical attention, hospitalization, and compensation.

The mines throughout the tables are designated by numbers, beginning with 1 for the mine producing the most coal and 13 for the mine producing the least coal from 1926 to 1931, inclusive.

Seven of these mines operated for the entire 6-year period, 2 for four years, 2 for two years, and 2 for only one year. During the period for which figures were furnished the total production was 3,703,547 tons of coal with 772 accidents resulting in the loss of ~~109,666~~ 119,566 days.

These 13 mines cover those of various ages, sizes, and classes in Tennessee; among them are slope mines, drift mines just above water level and drift mines high up on the mountainsides with long surface inclines, new mines and old mines, large producers and small producers, mines abundantly equipped with machinery and mines in which practically all work is done by hand, and also gassy and so-called nongassy mines. Although there may be mines in the State with better or worse accident experience, these 13 mines may be considered representative.

Production and Accidents

In Table 3 the mines are numbered in order of tonnage produced. The production, years covered by these figures, average days worked per year, total man-days worked, total lost-time accidents, and the days lost are shown. In the "total accident" column are included all accidents causing the loss of one or more days other than that on which the accident occurred. In the "days lost" column are days allowed by the State compensation law for death or permanent disability; the actual days lost are given for accidents not causing permanent disabilities.

The total of 772 accidents included 21 fatalities, 4 total permanent disabilities, 42 partial permanent disabilities, and 705 other lost-time accidents.

Table 3.- Production and accidents at 13 mines in Tennessee 1926 to 1931, inclusive

Mine	Total coal production, tons	Years active	Average employed	Total man-days worked	Total accidents	Days lost
1	687,390	6	258.1	294,042	213	30,032
2	581,896	6	188.3	221,819	66	13,156
3	434,247	6	143.8	169,396	78	17,971
4	415,373	6	134.4	158,323	51	12,910
5	339,316	6	154.8	183,354	111	7,903
6	337,237	6	109.1	128,520	37	1,808
7	276,959	4	137.2	115,348	91	15,290
8	272,520	6	82.1	97,714	45	2,146
9	206,293	4	113.4	95,256	50	11,412
10	67,390	2	203.5	77,534	15	943
11	45,395	2	106.0	40,986	7	3,079
12	32,986	1	52.0	9,620	4	2,855
13	6,545	1	55.0	10,175	4	61
Total	3,703,547	-	-	-	772	-

Accident Frequency and Severity

Table 4 lists the accidents for every mine as to severity and frequency with the days lost, as furnished by the operating company, and the days lost according to the schedule of lost days used in the national safety competition conducted annually by the United States Bureau of Mines.

Frequency is the number of lost-time accidents multiplied by one million divided by the number of man-hours worked.

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Severity is the days of time lost as a result of accidents multiplied by one thousand divided by the man-hours worked. In calculating the severity, the days lost are taken according to the national safety competition schedule.

Severity of accidents is a comparison of days lost as against days worked. In Table 4 the mines are arranged in the order of their severity rating; mine 13 has the best experience and mine 12 has the poorest; both of these mines operated only one year. A more nearly representative comparison would be in connection with mines working four or more years; on this basis mine 6 has the best severity experience and mine 7 the poorest. On a frequency basis, mine 7 has the poorest and mine 11 has the best record.

Table 4.- Accidents classified according to severity and frequency in 13 Tennessee mines, 1926 to 1931, inclusive

Mine	Fatals	Total permanent	Partial permanent	Other lost time	Tennessee, days lost	National competition, days lost	Total man-hours worked	Frequency	Severity
13	0	0	0	4	61	61	81,400	49.14	0.75
10	0	0	0	15	943	943	620,272	24.18	1.52
6	0	0	1	36	1,808	1,793	1,028,160	35.98	1.74
8	0	0	3	42	2,146	4,143	781,712	57.56	5.29
5	1	0	6	104	7,903	13,063	1,466,832	75.67	8.90
2	2	0	11	53	13,156	23,954	1,772,152	37.24	13.51
11	1	0	0	6	3,079	6,279	327,888	21.34	19.12
4	4	0	1	46	12,910	27,786	1,266,584	40.26	21.93
1	4	2	8	199	30,032	52,789	2,352,332	90.53	22.44
3	3	1	5	69	17,971	31,538	1,355,168	57.57	23.27
9	2	1	3	44	11,412	22,152	762,048	65.48	29.07
7	3	0	4	84	15,290	28,437	921,984	98.70	30.84
12	1	0	0	3	2,855	6,055	76,960	51.98	78.67

Cause of Accidents

In the classification of accidents, falls of roof and coal are responsible for the most lost days and haulage caused the greatest number of accidents. Flying coal caused many eye injuries, and employees on mining machines, in proportion to the number employed, have a high accident frequency. In the surface accidents, haulage has the highest frequency and severity. These accidents are listed by causes in Table 5.

Table 5.- Causes of accidents in 13 Tennessee mines, 1926 to 1931, inclusive

Cause	Fatal	Total disability	Part disability	Other lost-time accidents	Total lost-time accidents
Underground:					
Falls of roof or coal..	12	4	11	191	218
Flying coal or rock ...	0	0	5	41	46
Haulage	1	0	16	228	245
Electricity	2	0	0	13	15
Mining machines	0	0	3	29	32
Gas ignitions	0	0	1	3	4
Machinery	0	0	0	6	6
Explosives	0	0	0	5	5
Handling material	0	0	0	64	64
Tools	0	0	2	30	32
Falls of person	0	0	0	20	20
Nails	0	0	0	13	13
Miscellaneous	0	0	1	10	11
Surface:					
Haulage	6	0	1	14	21
Railroad cars	0	0	2	4	6
Machinery	0	0	0	10	10
Handling materials	0	0	0	15	15
Falls of person	0	0	0	5	5
Tools	0	0	0	4	4

Cost of Accidents

According to H. W. Heinrich of the Travelers Insurance Co. there are two kinds of accident costs - direct and indirect; the direct cost comprises medical, hospitalization, and compensation charges; the indirect or hidden cost includes time lost by the injured for which payment is not made by law or time lost by other employees, injury to equipment, loss of production, overhead expense, and other incidental costs of similar nature which usually accompany an accident. It is estimated by Heinrich as a result of analysis of a large number of industrial accidents that the indirect or hidden cost is four times as great as the direct cost of accidents.

In Table 6 the direct cost of accidents for the 13 mines is given on a cost per ton basis; this cost varies from 2.66 to 8.15 cents, with an average of 5.21 cents. The direct cost of accidents over the 6-year period was $192,904. If the direct and indirect cost ratio of 4 to 1 is used, then the total cost of accidents amounts to $964,520, or 26 cents per ton of coal.

Assuming that these mines are representative of all Tennessee coal mines for the same period, the direct cost of accidents for the State would be $1,560,611 and the total cost $7,803,056, or annually a direct cost of $260,102 and a total cost of $1,300,509.

Table 6.- Accident cost at 13 Tennessee mines

Mine	Coal produced, tons	Medical-hospital administration	Compensation	Total direct cost	Cost per ton, cents
6	337,237	4,924	4,357	9,281	2.75
10	67,390	389	1,536	1,925	2.86
8	272,520	3,302	3,944	7,246	2.66
5	339,316	3,787	8,199	11,986	3.53
13	6,545	302	34	336	5.15
2	581,896	8,496	22,494	30,990	5.33
9	206,293	2,079	9,903	11,982	5.81
1	687,390	7,581	32,627	40,208	5.85
7	276,959	1,590	14,677	16,267	5.87
4	415,373	6,064	20,654	26,718	6.43
3	434,247	7,701	22,163	29,864	6.88
11	45,395	258	3,154	3,412	7.52
12	32,986	344	2,345	2,689	8.15

SUMMARY

Table 7 is a brief summary of the accident experience of the 13 mines. While this is not the best nor is it the worst accident experience for mines, groups of mines, or mining States, it will present an opportunity for those interested to compare their mines, districts, or State with some actual direct accident-cost figures.

Table 7.- Summary of accident data for 13 Tennessee mines in the period 1926-1931

Number of mines		13
Coal produced	tons	3,703,547
Man-days worked		1,601,987
Fatal accidents		21
Total permanent disabilities		4
Part permanent disabilities		42
Temporary disabilities		705
Total lost-time accidents		772
Total time lost	days	218,993
Time lost per accident	days	283.7
Accidents per fatality		36.8
Coal per accident	tons	4,797
Coal per day lost	tons	16.9
Direct cost	cents per ton	5.21
Frequency		60.25
Severity		17.09

CONCLUSION

The accidents in these 13 mines, as well as those in other Tennessee mines, unquestionably can be reduced in frequency, severity, and cost by the proper training of all employees and by better and closer supervision. Even if the total cost of accidents in the coal mines of Tennessee should not actually reach the 26 cents per ton as is indicated in the analysis in this paper, there is no question that the cost of coal-mine accidents not only in human suffering and misery but also in dollars and cents is excessive. There is also no question that all of these various kinds of accident costs can be materially decreased by the use of readily available accident prevention methods, and there is no good reason why at least half of present accident costs of all kinds in Tennessee coal mines can not be saved.